



Green Infrastructure:

**A Natural, Cost-Effective
Way to Address the CSO Issue**

Combined Sewer Overflow





Green Infrastructure Potential

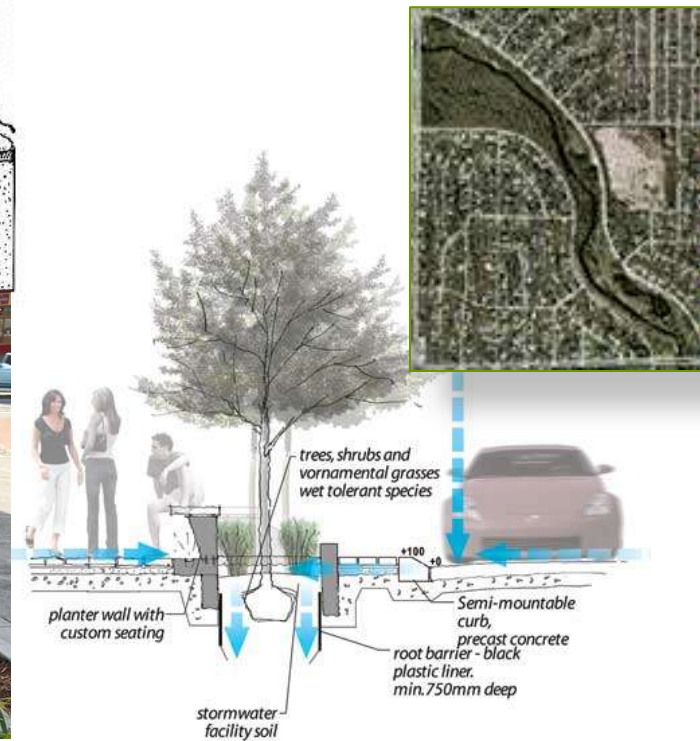
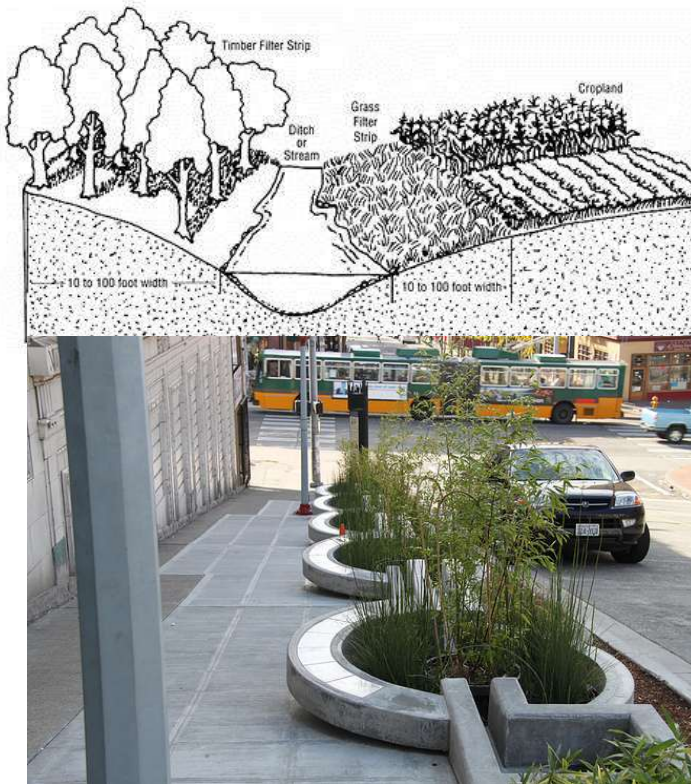
**GREEN INFRASTRUCTURE AREAS AND
EAST CSS SUBCATCHMENT AREAS**

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Sewer Service Areas



What is Green Infrastructure ?



A dark grey rectangular box with a thin green border is positioned in the top right corner of the slide.

Types of Green Infrastructure

Natural, Restored Wetlands



Natural, Restored Wetlands

- Diverse Natural Surroundings
- “Kidneys of Nature”
- Runoff Control

Urban Constructed Wetlands



Tianjin Qiaoyuan Wetland Park, China - Photo by Cao Yang

Urban Constructed Wetlands

- Only Type of Wetland Used for Treating CSOs
- Traps and Ingests Pollutants, Treats Waste
- Less Maintenance than Mechanical Treatment Plants

Urban Stream Restoration



Urban Stream Restoration

- **Bringing Buried Streams to the Surface**
- **Only Possible when Point Source Pollution is Eliminated**
- **Complex Process Using Best Management Practices**

Urban Stream Restoration



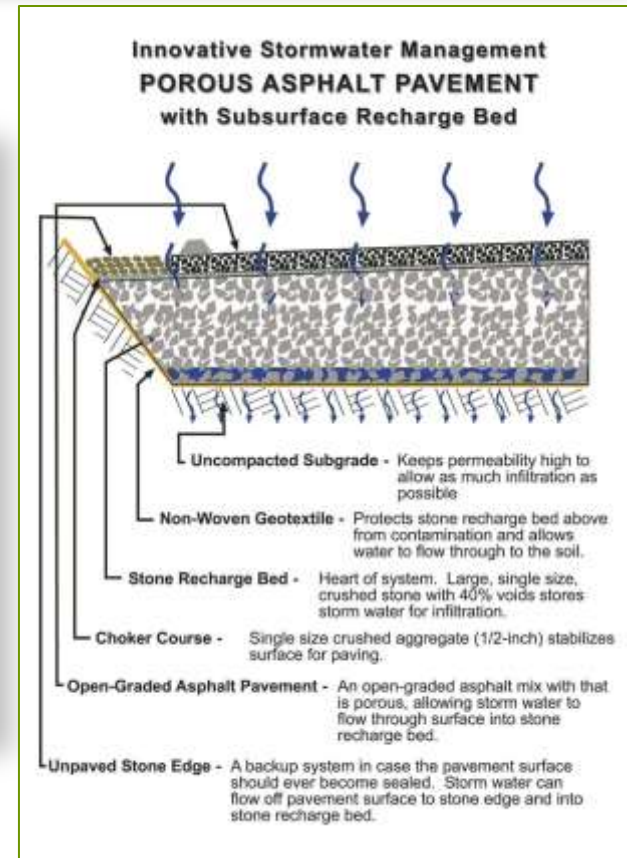
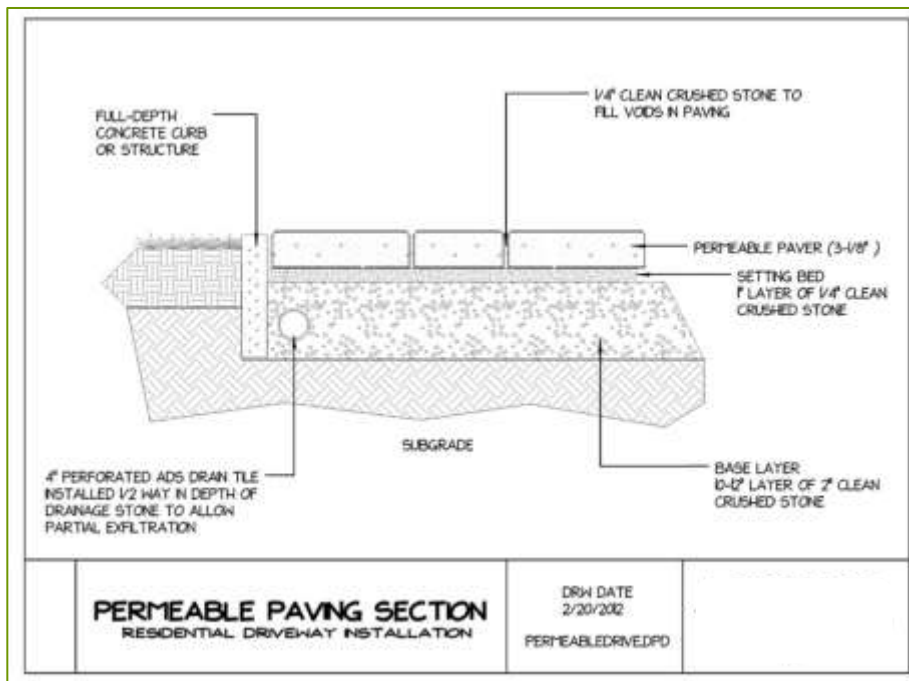
Porous (Pervious) Pavements



Porous (Pervious) Pavements

- **Asphalt/Concrete with Fine Filler Fractions Missing**
- **Water Percolates through Pavement into Sub-base**
- **Low-use Roadways, Parking Lots, and Alleys**

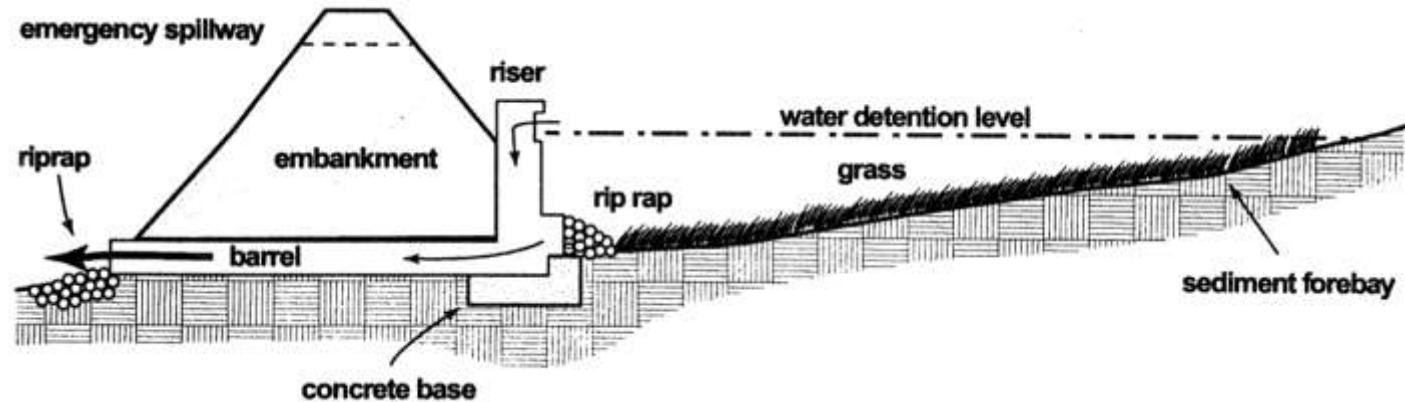
Porous (Pervious) Pavements



Interlocking Pavers



Dry Detention Ponds



Green Roofs and Walls



Green Roofs and Walls

Intensive Living Roof

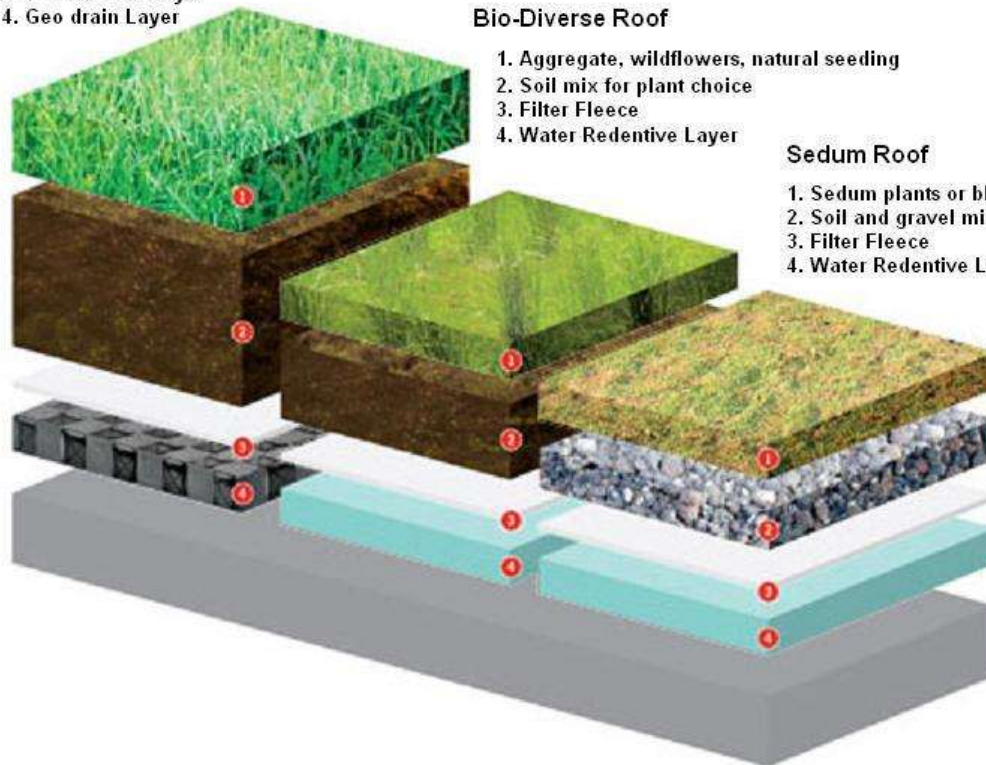
1. Paving, Decking, Large plants
2. 300mm plus Deep Soil Substrate
3. Filter Fleece Layer
4. Geo drain Layer

Bio-Diverse Roof

1. Aggregate, wildflowers, natural seeding
2. Soil mix for plant choice
3. Filter Fleece
4. Water Redentive Layer

Sedum Roof

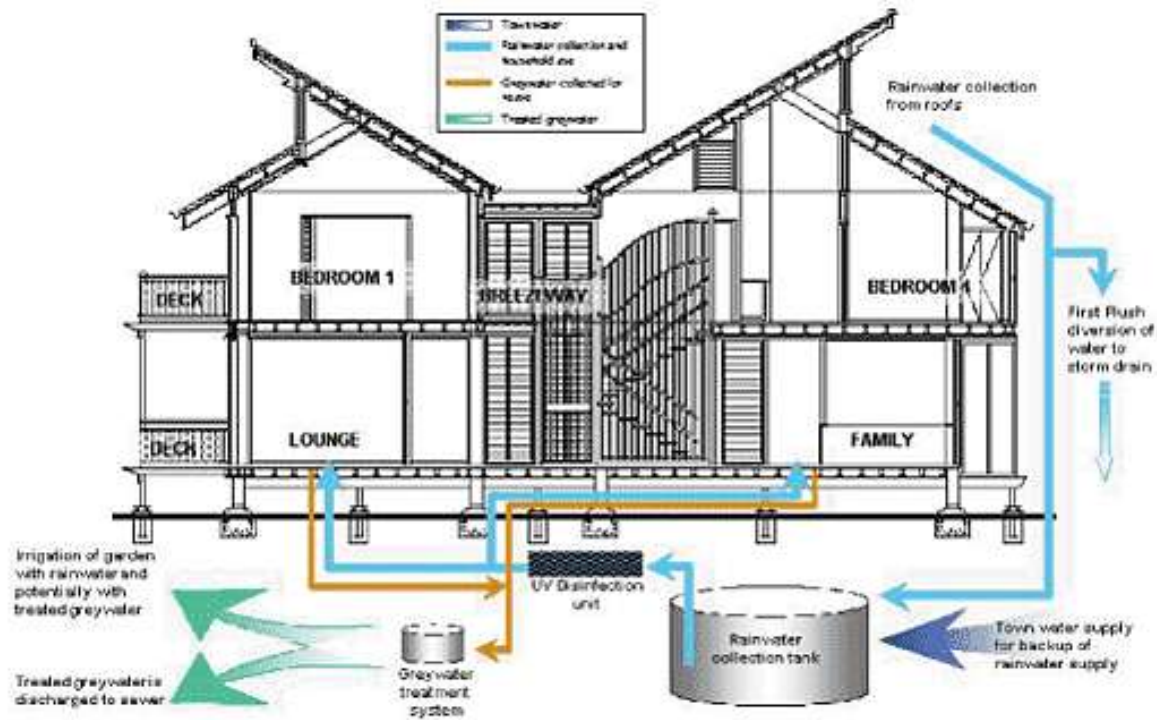
1. Sedum plants or blanket
2. Soil and gravel mix
3. Filter Fleece
4. Water Redentive Layer



Green Roofs and Walls



Rainwater Harvesting

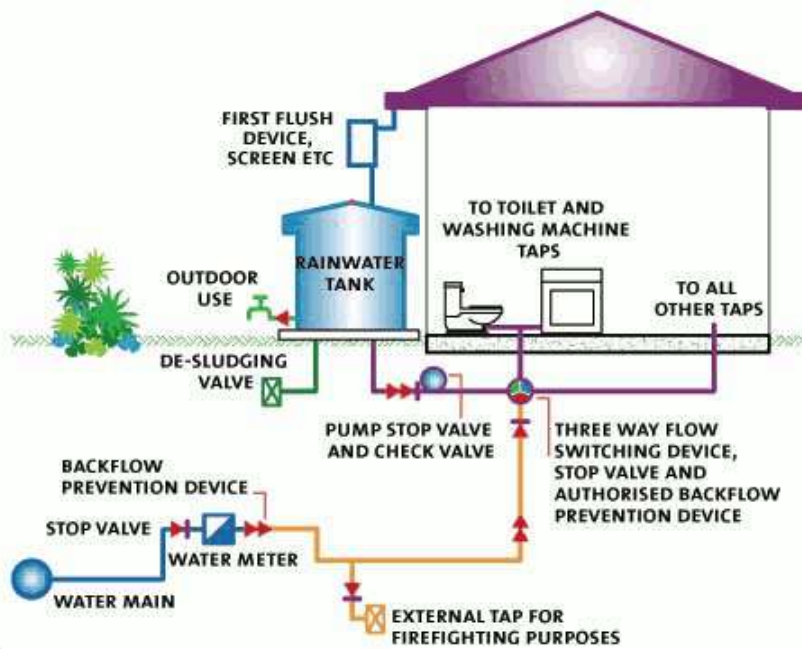


Rainwater Harvesting

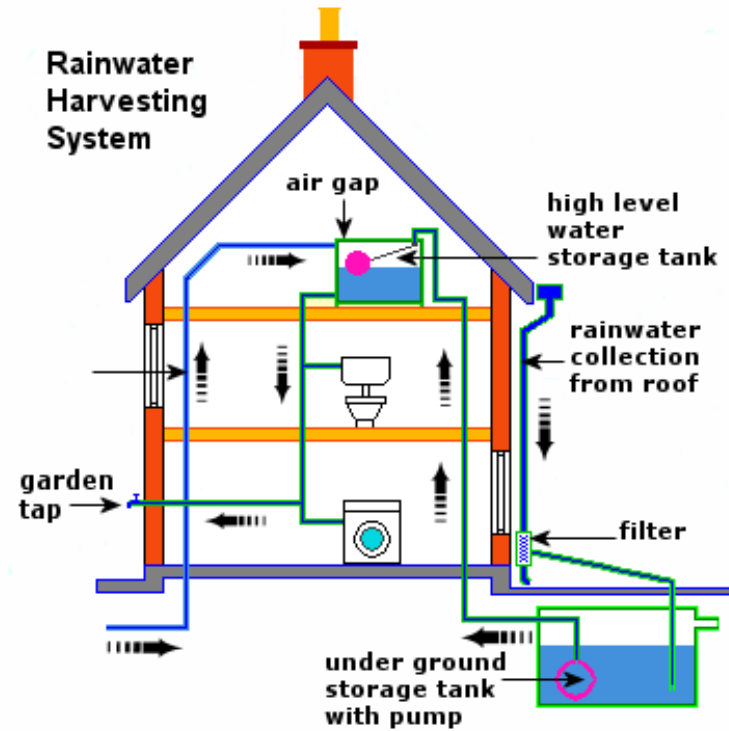
- Simple and Inexpensive to Install and Operate
- Movement to Clustered “Eco-Block” Management Schemes
- Graywater Mostly for Nonpotable Uses

Rainwater Harvesting

Residential rainwater tank connected to a 'top-up' system providing rainwater to outdoor, toilet and washing machine only.



Rainwater Harvesting System



Rain Gardens:

- Versatile – Any Size or Shape (Use “Deadspaces”)
- Water can Pond up to Several Inches
- Use Native Plants with Deep, Fibrous Root Structure
- Particle Settlement and Nutrient Uptake/Treats Pollutants

Rain Gardens



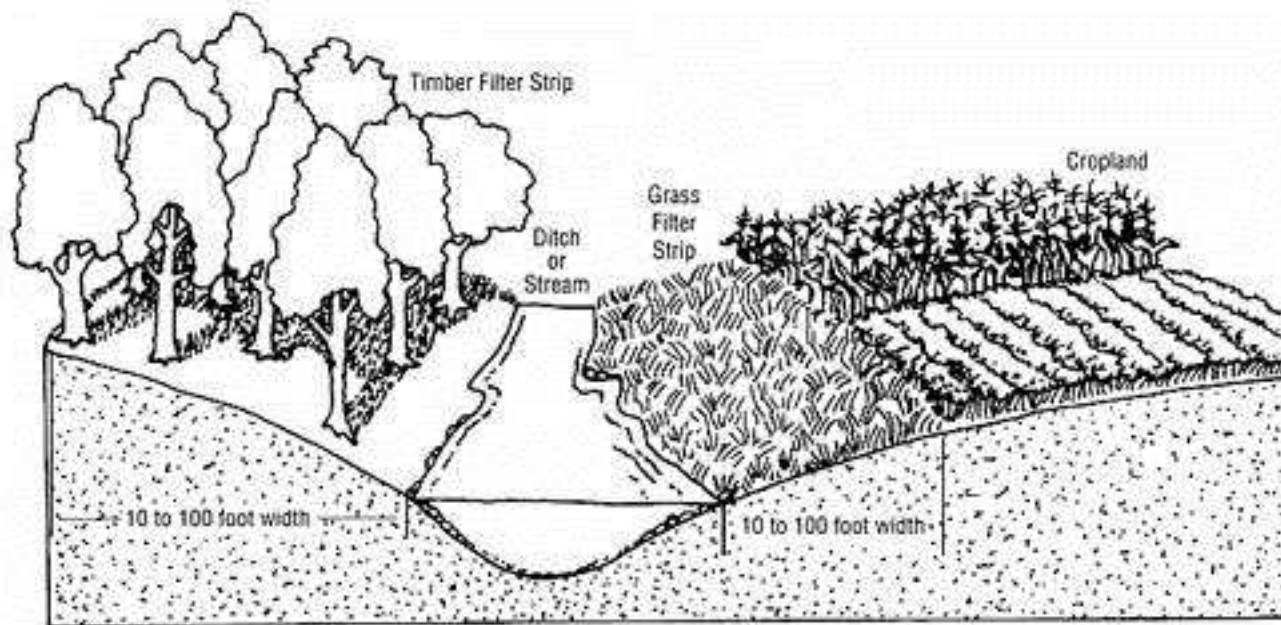
Vegetated Swales & Filter Strips



Vegetated Swales & Filter Strips

- **Relatively Inexpensive & Easy to Maintain**
- **Remove Silt and Pollutants Before Discharging into Storm Sewers**
- **Excellent for Receiving Sheet Flow from Parking Lots**

Vegetated Swales & Filter Strips

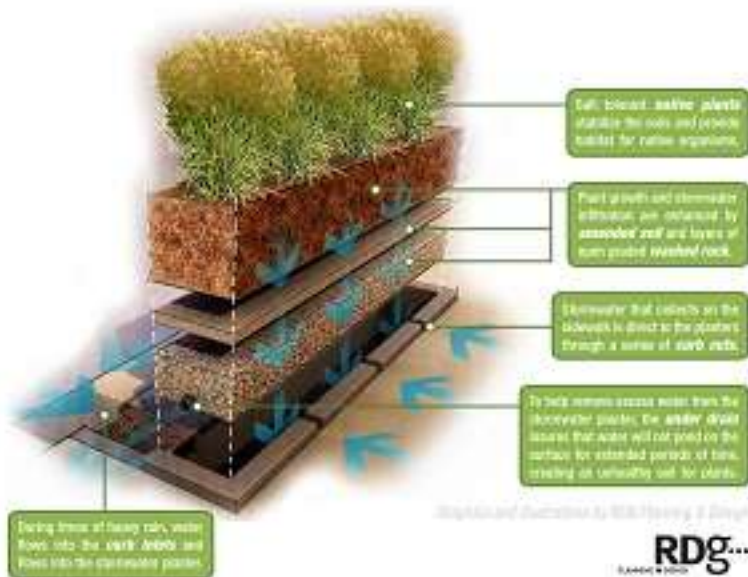


Storm Water Planters



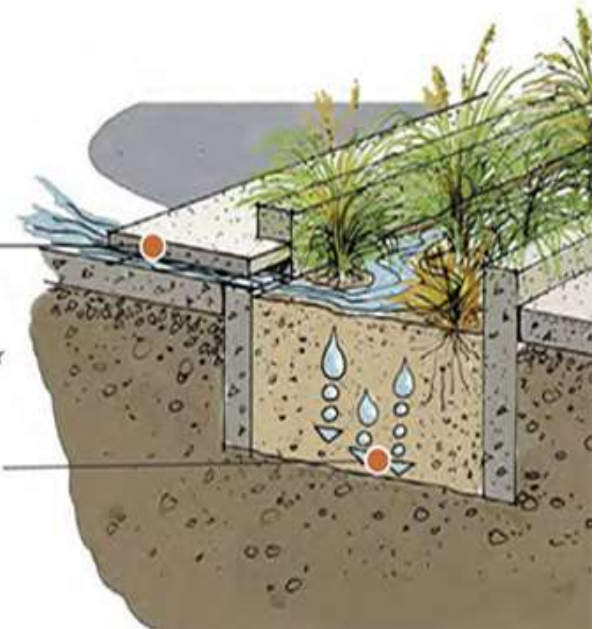
Storm Water Planters

Stormwater planters capture the street's stormwater runoff before it enters into city's storm sewer. By promoting stormwater infiltration, the planters remove pollutants and debris, that would otherwise be released directly into the Mississippi River.

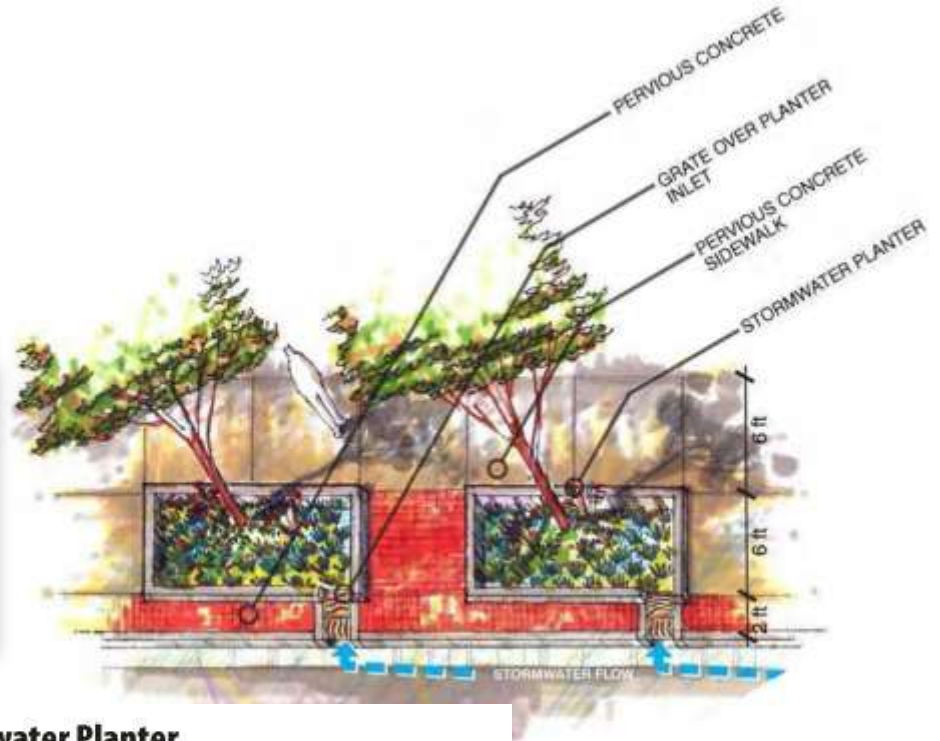


Water from the street enters planter through openings in the curb.

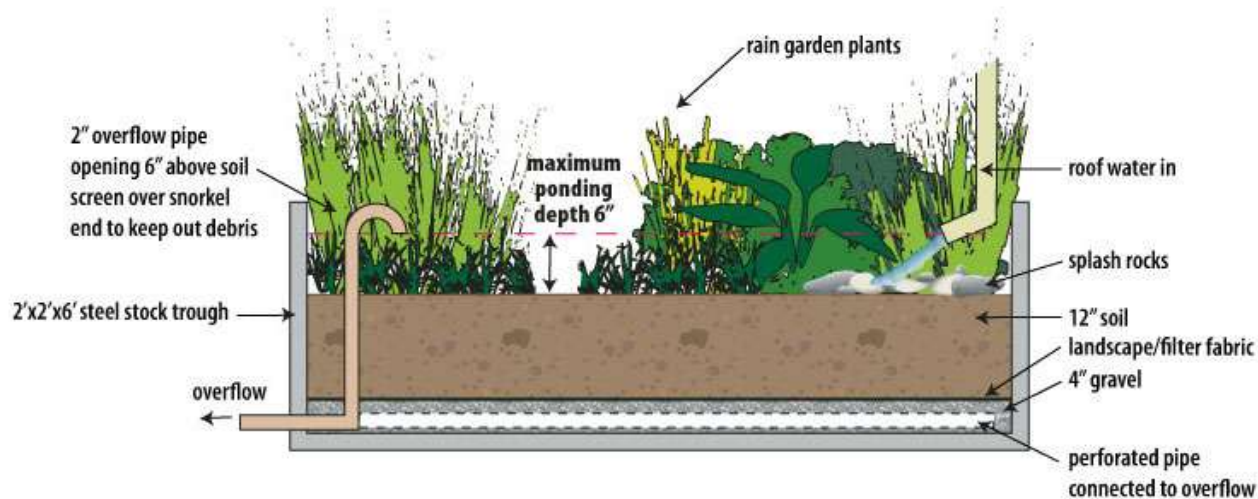
During heavy rains, overflow exits one planter at the lower end and enters the next planter.



Storm Water Planters

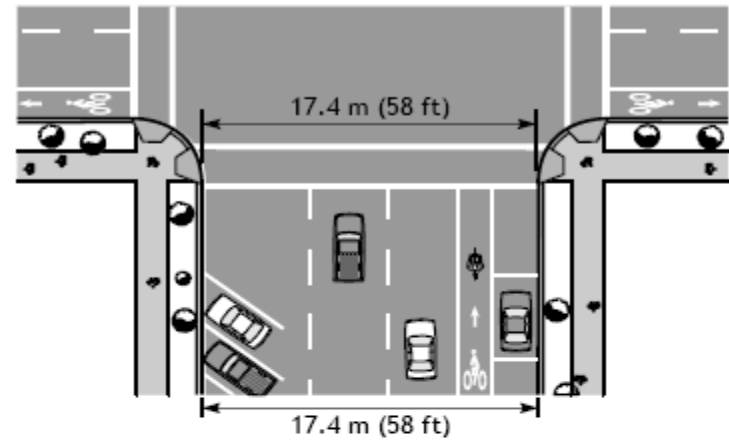


2'x2'x6' Stock Trough Stormwater Planter

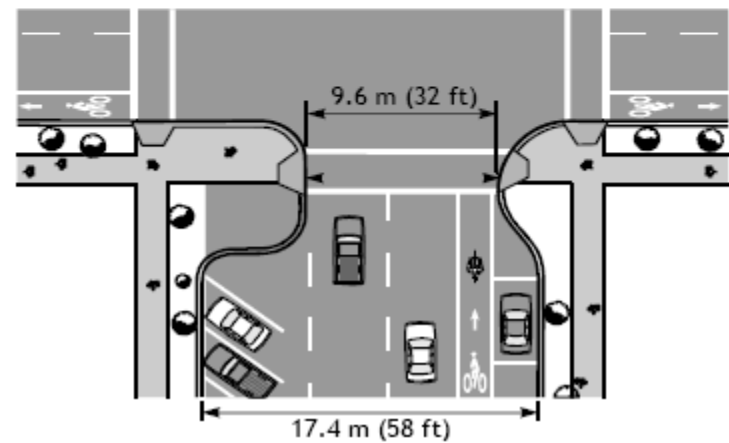


Curb Extensions

Before



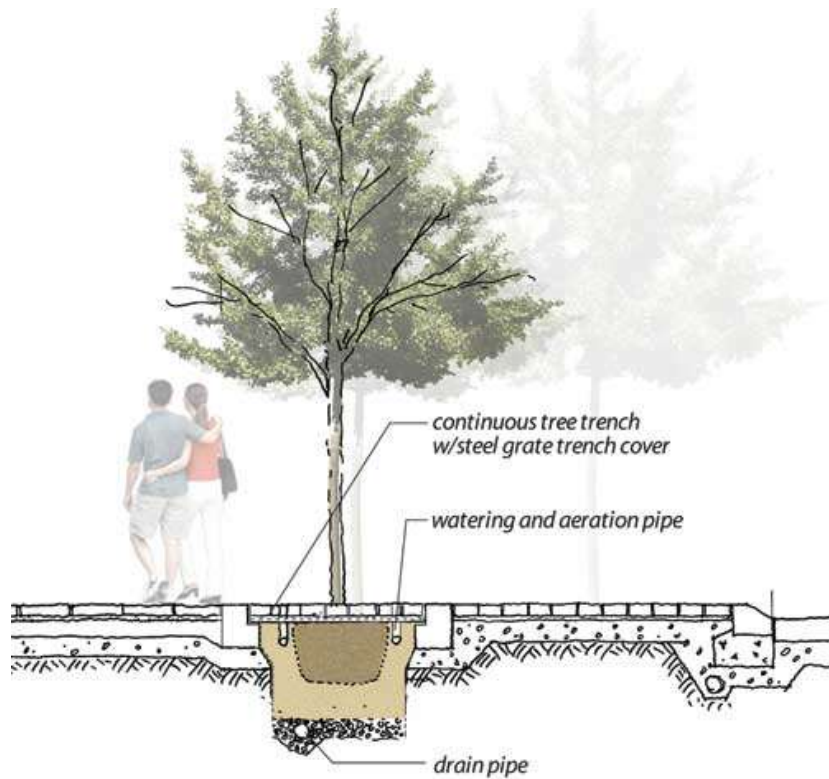
After



Curb Extensions



Green Gutters



Stormwater Tree



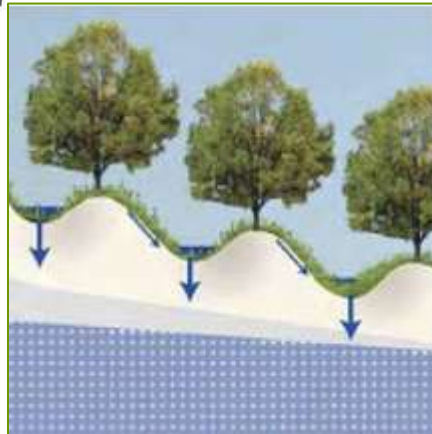
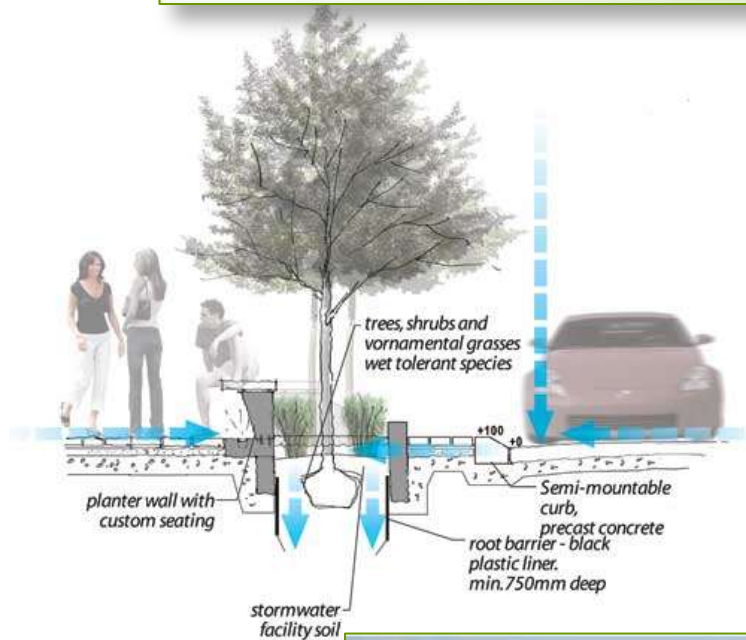
Stormwater Tree Trench



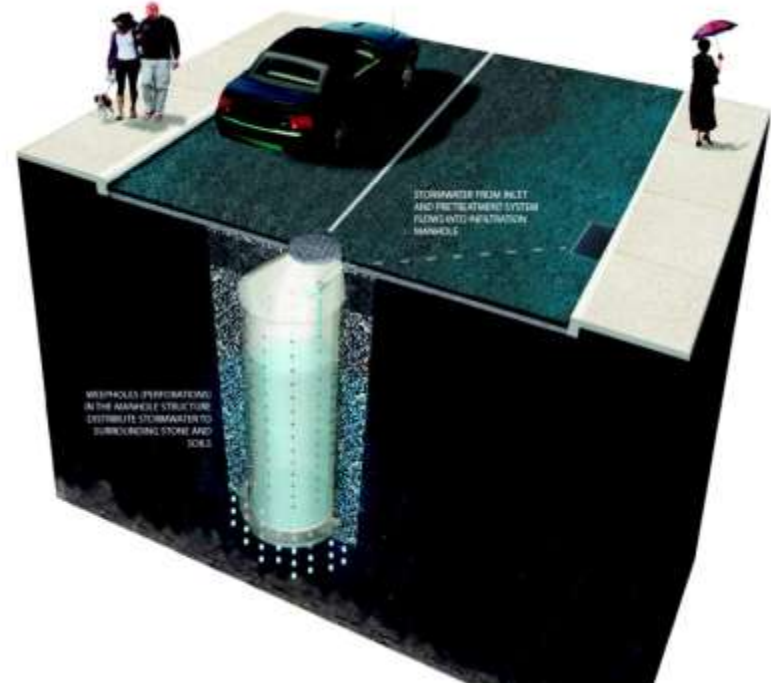
Corner Bump-out



Infiltration Beds and Berms



Dry Wells



Dry Wells:

- **Otherwise Known as Seepage Pits or French Drains**
- **Precast Structural Chamber or Pit Filled with Coarse Stone**
- **Well-Defined Drainage Area, One Acre or Less**

Plant & Wildlife Corridors





Downtown Evansville Projects

Civic Center



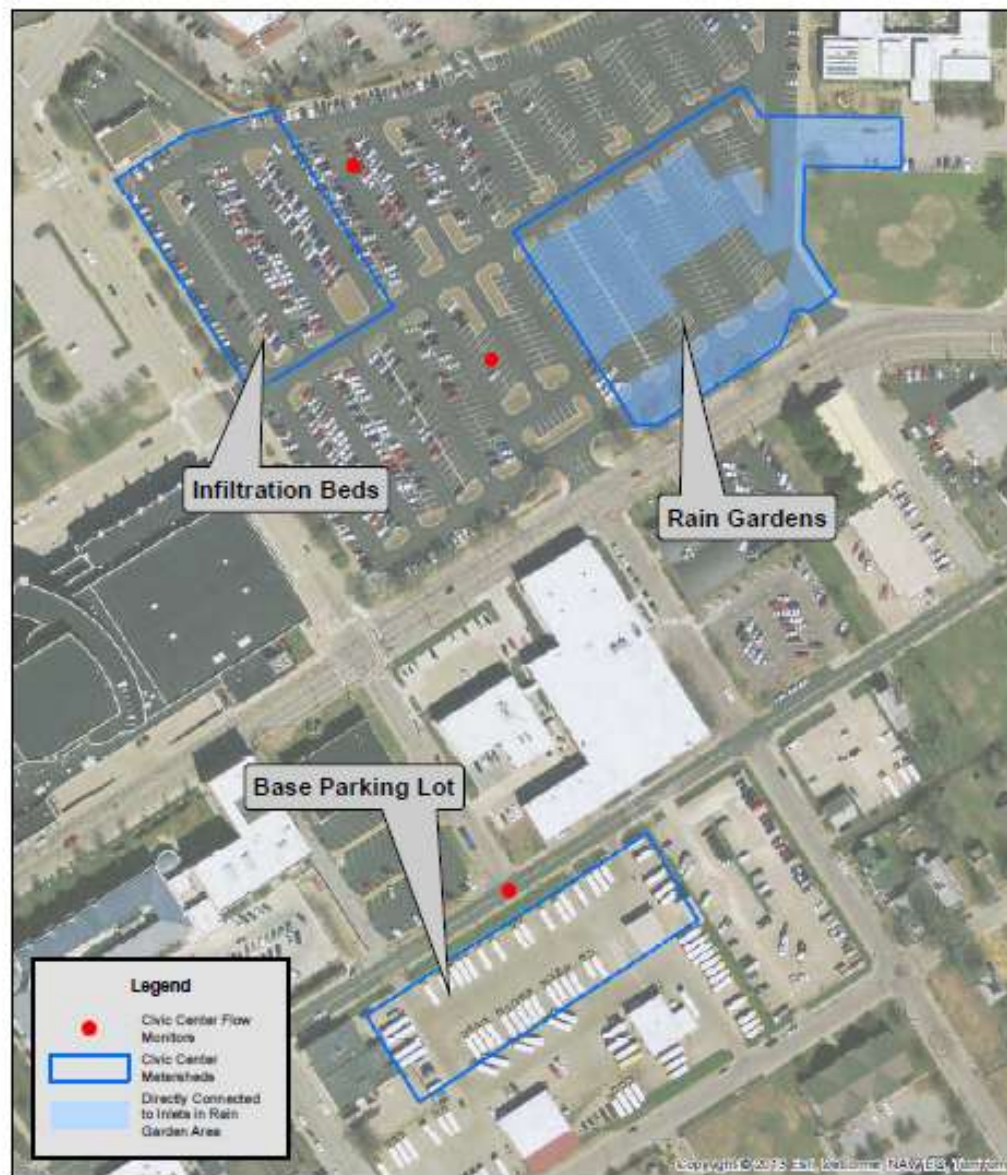




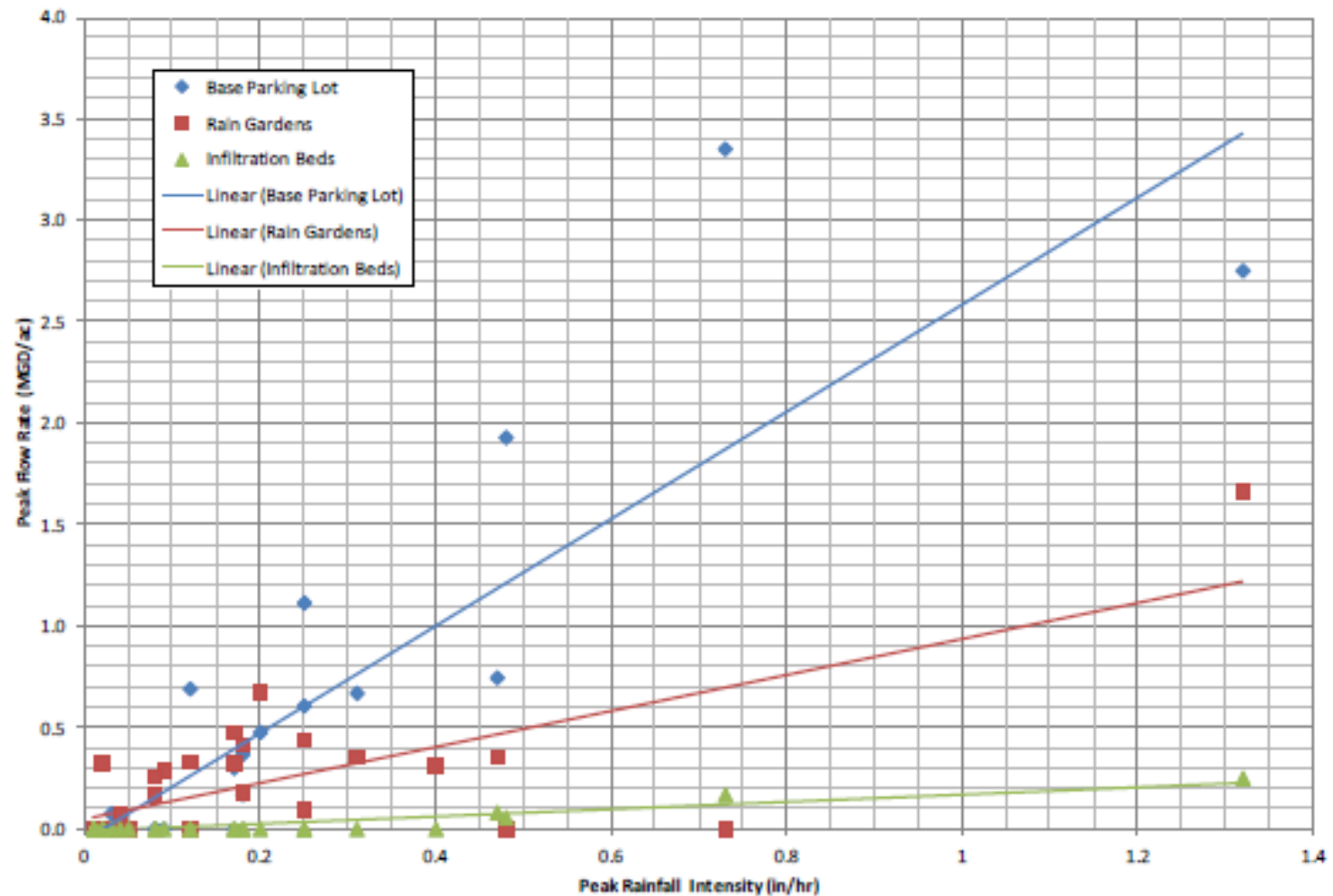




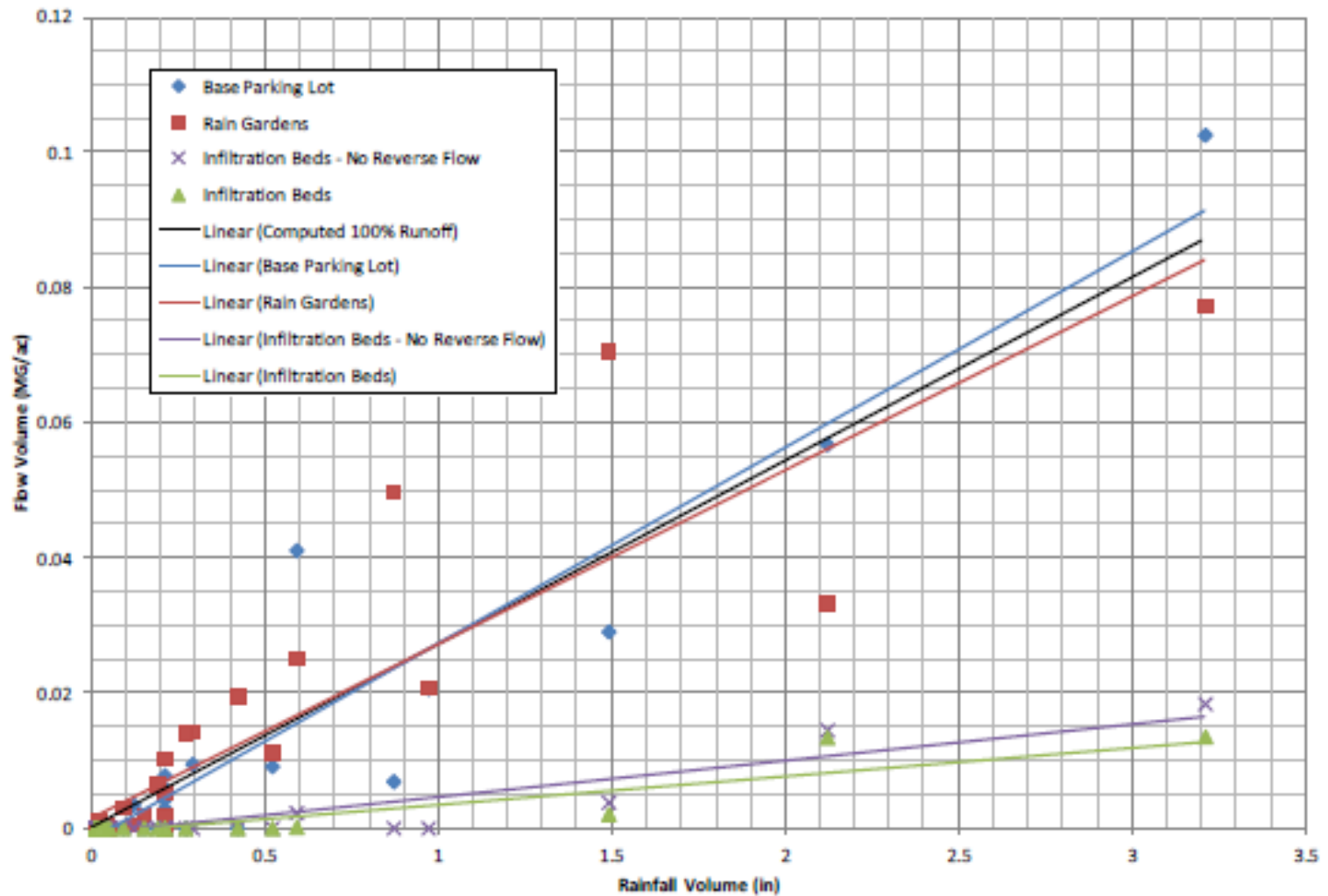
Civic Center Metersheds



Peak Rainfall Intensity vs. Peak Flow Rate

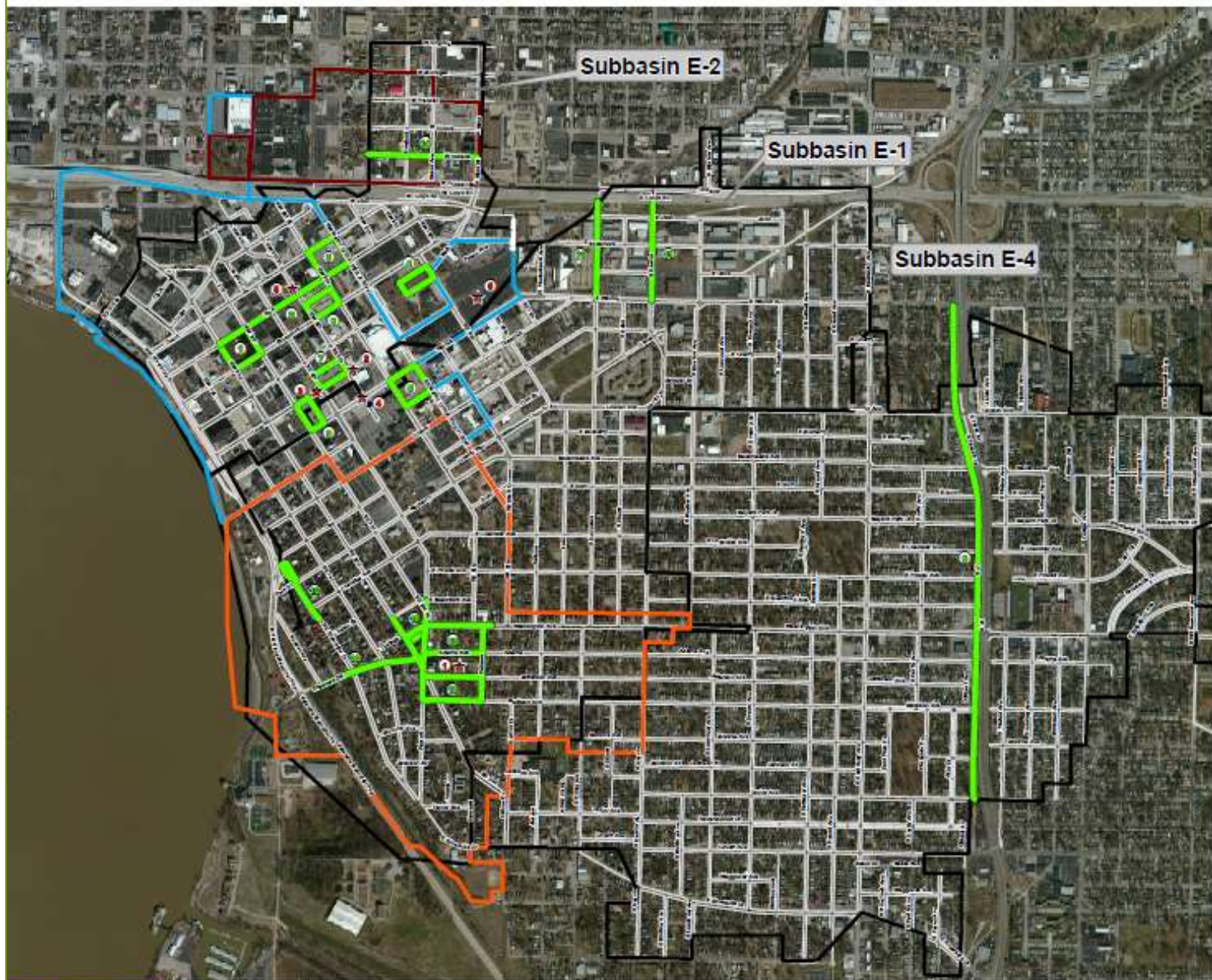


Rainfall Volume vs. Flow Volume





Green Infrastructure Participation Program



GI Participation Plan

- Reduce CSO Volumes & Peaks
- Incentivize Redevelopment
- Verify Effectiveness
- Participate for Success

GI Participation Plan Steps

- Calculate Drainage Area for GI Device (sq.ft.)
- Determine Project Runoff Coefficient (C)
- Calculate the size of storm captured
- Determine the % of Annual Rainfall Captured.

Utility Participation

$$\text{\$} = 0.0565 \times C \times \% \text{ Annual Rainfall} \times \text{sq.ft.}$$

GI Participation Plan Steps

- **Submit Participation Plan (Business Plan) to Utility**
 - Review Plan Implements
 - Review O&M Requirements
 - Review O&M Agreements
- **Recommend Participation to the Board**
- **Payout with Post-Construction Verification**

Vacant Properties with Green Infrastructure Storm Drain Potential



1301 Eichel



322 Cherry Street



601 Blackford Street



1434 SE Riverside Drive



426 Madison Street



430 S Grand Avenue



905 S Garvin Street



905 S Garvin Street CB



909 Line Street



909 Line St. Mt. Olive Church



320 Washington Avenue



Garvin & Washington Avenue



1101 S Grand Avenue



915 Washington Avenue



915 Washington Avenue CB



1500 Taylor Street



1614 Evans



1614 Evans Church



1418 Culver



1418 Culver Sewer Inlets





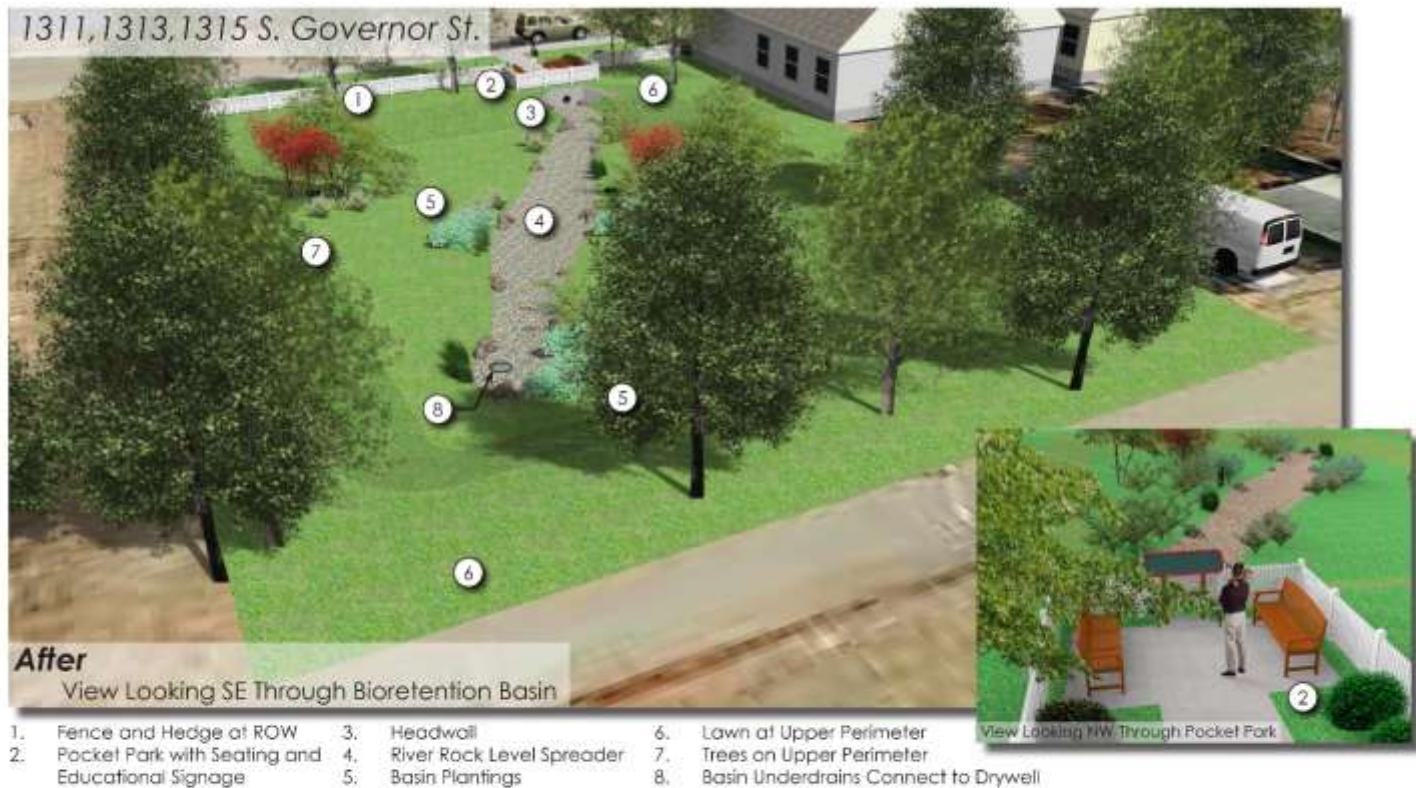
Treatment of Vacant Lots




Treatment of Vacant Lots



Treatment of Vacant Lots





Green Infrastructure Education & Outreach

Our Task

- Develop a set of educational "tools" to guide transition from Gray to Green.
- Create Education and Outreach program to address stakeholder needs.
- Support Developers with planning, programming, budgeting and execution of Green Infrastructure transition program.

GI Participation Program

- Geographic Area
- GI Part. Prog. Purpose
- Storm Water Reduction Options
- Cost Analysis
- GI Requirements
- Define GI
- GI Types
- Local Ordinance
- Aesthetics
- LEED
- Education & Outreach
- GI Challenge

GI Starting Point

- Education and Outreach
- Gain Stakeholder Buy-In
- Equip Decision Makers with Tools
- Listen – Engage – Plan

Listen

In order to turn strategy into action, the Utility must gain buy-in from key stakeholders. Undertake a Gap analysis to gauge the public's level of knowledge and interest. The goal is to support GI becoming a standard practice to accomplish the following:

- Mimic nature and encourage rain infiltration where it falls
- Demonstrate curb appeal and environmental benefits
- Reduce Storm water management costs
- Exceed compliance with storm water regulatory requirements under Clean Water Act

Listen to Stakeholders

- Stakeholders: Developers, Local Officials, Community
- Tool # 1 - GI Gap Analysis & Assessment
- Focus Groups

Engage

Develop a set of tools that will enable stakeholders to serve as "role models" of storm water stewardship as they are engaged in leading the planning efforts. Outreach strategy will analyze current storm water management issues and develop an approach to address:

- Develop a set of tools to guide transition from Grey to Green
- Storm water management and related discharge, elimination and construction site controls
- Basic awareness of storm water management and GI design solutions
- Recognition and leadership award/challenge programs

Engage Stakeholders

- Engages the learner as an active participant which facilitates positive behavior change
- Tool # 2 Outreach Strategy
 - Provides clients a variety of single-session and multi-session education options
- Tool # 3 Training Program
 - Education programs offered in classroom, webinar or video formats

PLAN

Innovation in the area of green infrastructure is evolving as government regulatory requirements increase around storm water management. As project managers, engineers and architects strive to maximize short-term results on a construction task, they will require support with integrating the GI solutions into their basic management functions:

- Planning
- Scheduling
- Estimating and Budgeting
- Monitoring Progress and Performance
- Taking Corrective Action as Required

GI – Stakeholder's Plan

- Paradigm Shift – Starting Point:
 - Step 1: Foundation for Success
 - Step 2: Defining Measures of Success
 - Step 3: Create Policies
 - Step 4: Provide Tools
 - Step 5: Create Sustainable Program
- Tool # 4: Stakeholder Charrettes



Green Infrastructure

Questions ?